

An extension of time to respond to the Office Action is respectfully requested. A Petition for Extension of Time and the appropriate fee are being filed concurrently with this Amendment.

Please amend the application as follows:

In the Claims

Please cancel Claims 18 and 23.

Please amend Claims 1-2, 4-7, 9-11, 14-17, 19-21, and 25. Amendments to the claims are indicated in the attached "Marked Up Version of Amendments" (pages i - iv).

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1. (Twice Amended) A method for calibrating a camera comprising the steps of:
digitizing an image of a blank textureless surface having a uniform illumination;
from the digitized image, determining pixel intensity drop off caused by a
vignetting effect; and
computing an intrinsic parameter of the camera other than pixel intensity drop off
using the determined pixel intensity drop off.
2. (Twice Amended) The method as claimed in Claim 1 wherein the pixel intensity drop off
is also caused by an off-axis pixel projection effect.
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4. (Amended) The method as claimed in Claim 1 wherein the step of computing is dependent
on a camera tilt effect.
5. (Amended) The method as claimed in Claim 1 further comprising the step of computing
the parameters of a model by minimizing the difference between the digitized image and
the model.
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6. (Twice Amended) A computer program product for calibrating a camera, the computer
program product comprising a computer usable medium having computer readable code
thereon, including program code which:
- C1
- C2
- C3
cont

retrieves a digitized image of a blank textureless surface having a uniform illumination;

from the digitized image, determines pixel intensity drop off caused by a vignetting effect; and

computes an intrinsic parameter of the camera other than pixel intensity drop off based on the determined drop off.

- C3
7. (Amended) The computer program product as claimed in claim 6 wherein the pixel intensity drop off is also caused by an off-axis pixel projection effect.

- C4
9. (Amended) The computer program product as claimed in claim 6 wherein the program code computes parameters based on a camera tilt effect.

10. (Amended) The computer program product as claimed in claim 6 wherein the program code computes parameters of a model by minimizing difference between the digitized image and the model.

- C5
11. (Amended) A computer system comprising:
a memory system;
an I/O system connected to the memory system;
a storage device connected to the I/O system; and
a calibration routine located in the memory system responsive to a request for calibrating a camera which:

retrieves a digitized image of a blank textureless surface having a uniform illumination;

from the digitized image, determines pixel intensity drop off caused by a vignetting effect; and

computes an intrinsic parameter of the camera other than pixel intensity drop off based on the determined drop off.

- C6
14. (Amended) The computer system as claimed in claim 11 wherein the calibration routine computes parameters dependent on a camera tilt effect.

6 15. (Amended) The computer system as claimed in claim 11 wherein the calibration routine computes parameters of a model stored in the storage device, by minimizing difference between the digitized image and the model.

e7 16. (Twice Amended) An apparatus for calibrating a camera comprising:

means for digitizing an image of a blank textureless surface having a uniform illumination;

means for determining pixel intensity drop off in the digitized image caused by a vignetting effect; and

means for computing an intrinsic parameter of the camera other than pixel intensity drop off using the determined pixel intensity drop off.

17. (Twice Amended) The apparatus as claimed in claim 16 wherein the pixel intensity drop off is also caused by an off-axis pixel projection effect.

c8 19. (Amended) The apparatus as claimed in claim 16 wherein the means for computing computes parameters based on a camera tilt effect.

20. (Amended) The apparatus as claimed in claim 16 wherein the means for computing further comprises means for computing parameters of a model by minimizing difference between the digitized image and the model.

CQ 21. (Twice Amended) An apparatus for calibrating a camera comprising:

a retrieval routine which retrieves a digitized image of a blank textureless surface having a uniform illumination;

a routine which determines pixel intensity drop off in the digitized image caused by a vignetting effect; and

a parameter computing routine which computes an intrinsic parameter of the camera other than the pixel intensity drop off using the determined pixel intensity drop off.

- CD*
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25. (Amended) The apparatus as claimed in claim 21 wherein the parameter computing routine further comprises a model routine which computes parameters of a model by minimizing difference between the digitized image and the model.
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Please add new Claims 26-46.

- CD*
- Cond*
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26. The method as claimed in Claim 2 wherein the intrinsic parameter is selected from the group consisting of focal length, principal point, skew and aspect ratio.
27. The method as claimed in Claim 2 wherein the intrinsic parameter is focal length.
28. The method as claimed in Claim 2 wherein the intrinsic parameter is principal point.
29. The method as claimed in Claim 2 wherein the intrinsic parameter is skew.
30. The method as claimed in Claim 2 wherein the intrinsic parameter is aspect ratio.
31. The computer program product as claimed in Claim 7 wherein the intrinsic parameter is selected from the group consisting of focal length, principal point, skew and aspect ratio.
32. The computer program product as claimed in Claim 7 wherein the intrinsic parameter is focal length.
33. The computer program product as claimed in Claim 7 wherein the intrinsic parameter is principal point.
34. The computer program product as claimed in Claim 7 wherein the intrinsic parameter is skew.
35. The computer program product as claimed in Claim 7 wherein the intrinsic parameter is aspect ratio.

- all*
36. The computer system as claimed in Claim 11 wherein the intrinsic parameter is selected from the group consisting of focal length, principal point, skew and aspect ratio.
 37. The computer system as claimed in Claim 11 wherein the intrinsic parameter is focal length.
 38. The computer system as claimed in Claim 11 wherein the intrinsic parameter is principal point.
 39. The computer system as claimed in Claim 11 wherein the intrinsic parameter is skew.
 40. The computer system as claimed in Claim 11 wherein the intrinsic parameter is aspect ratio.
 41. The apparatus as claimed in Claim 16 wherein the intrinsic parameter is selected from the group consisting of focal length, principal point, skew and aspect ratio.
 42. The apparatus as claimed in Claim 16 wherein the intrinsic parameter is focal length.
 43. The apparatus as claimed in Claim 16 wherein the intrinsic parameter is principal point.
 44. The apparatus as claimed in Claim 16 wherein the intrinsic parameter is skew.
 45. The apparatus as claimed in Claim 16 wherein the intrinsic parameter is aspect ratio.
 46. A method for calibrating a camera comprising the steps of:
digitizing an image of a blank textureless surface having a uniform illumination;
from the digitized image, determining pixel intensity drop off caused by a vignetting effect; and
computing focal length of the camera using the determined pixel intensity drop off.